OBJECTIVE:

Design 1 X 2 Circular Patch Array antenna working at 2.4 GHz and having gain of 5.74 dB

DESIGN:

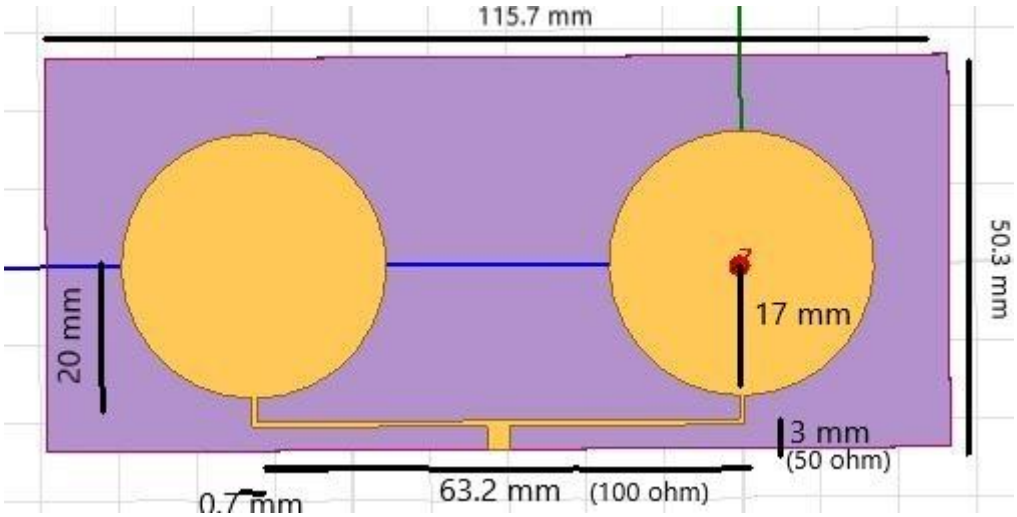


Figure 1: Patch & Ground Dimension

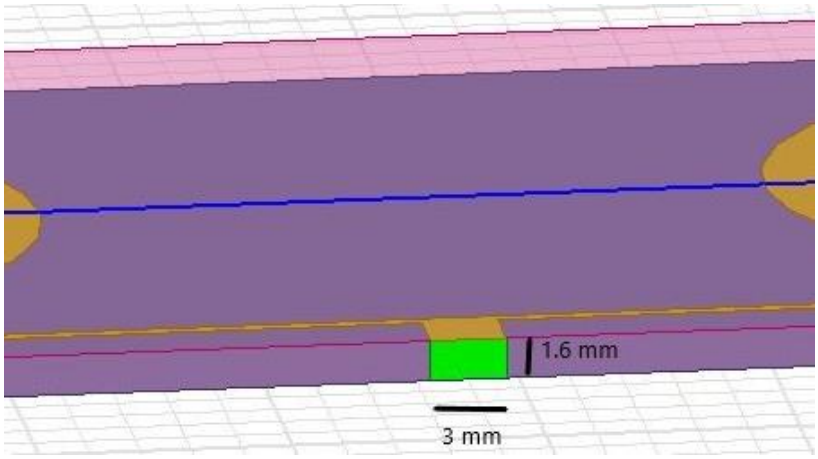


Figure 2: Lumped Port Excitation Source Dimension

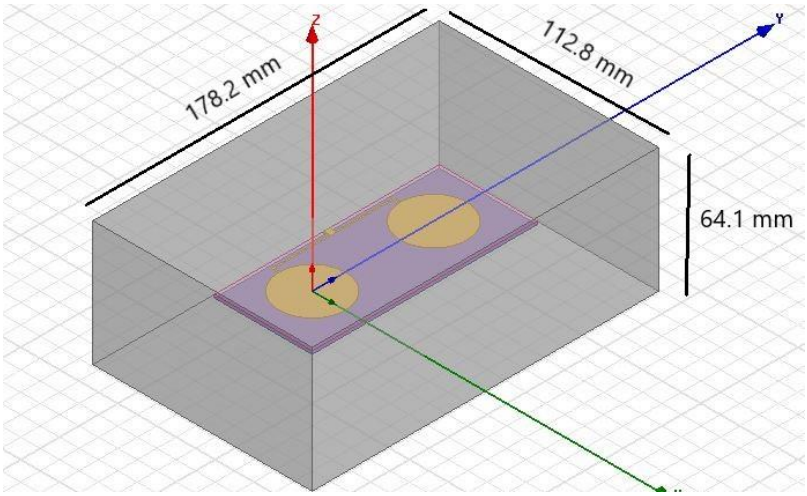
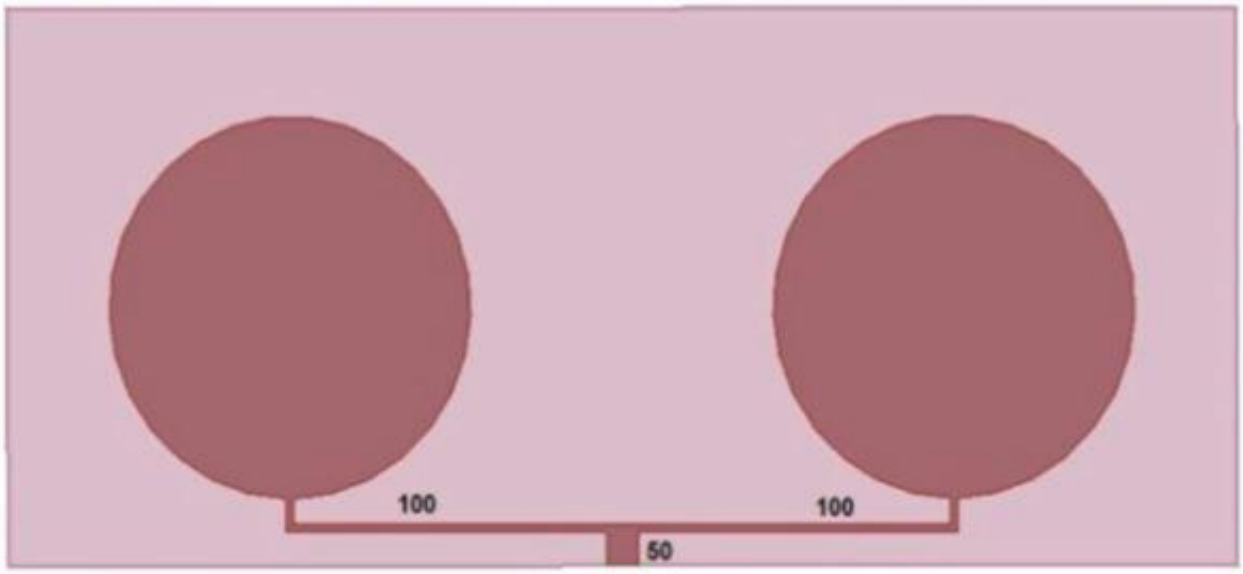


Figure 3: Radiation Box Dimension



Each of the patch is connected to 100Ω feedline.

The equivalent at the junction of the two 100Ω lines is 50Ω.

50Ω feedline is connected to edge feed.

The calculated dimensions are below

Radius of the Patch	17 mm
Inter-element spacing	62.5 mm
Width of 100Ω feedline	0.7 mm
Width of 50Ω feedline	3 mm

Radius of Patch (a) is calculated by:

$$a = \frac{F}{\left\{1+\frac{2h}{\pi\varepsilon F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right\}^{\frac{1}{2}}}$$

$$\text{Where } F = \frac{8.791\times10^{9}}{f_r\sqrt{\varepsilon}}$$

Interspacing of element should be between lambda to lambda/2.

lambda = c/f

f = resonant or centre frequency for which antenna is designed.

Width of feedline is calculated using:

$$Z_c = \begin{cases} \frac{60}{\sqrt{\epsilon_{reff}}} \ln\left[\frac{8h}{W_0} + \frac{W_0}{4h}\right], & \frac{W_0}{h} \le 1 \\ \frac{120\pi}{\sqrt{\epsilon_{reff}}\left[\frac{W_0}{h} + 1.393 + 0.667 \ln\left(\frac{W_0}{h} + 1.444\right)\right]}, & \frac{W_0}{h} > 1 \end{cases}$$

These widths can be calculated on the link provided below:

https://www.emtalk.com/mscalc.php

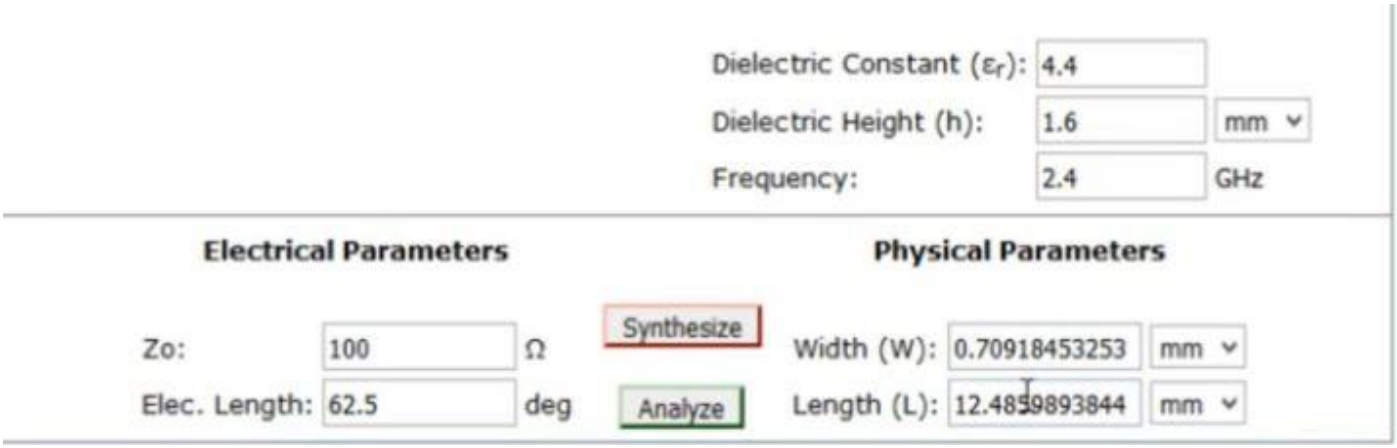


Figure 4: Feed line width calculator for 100-ohm line

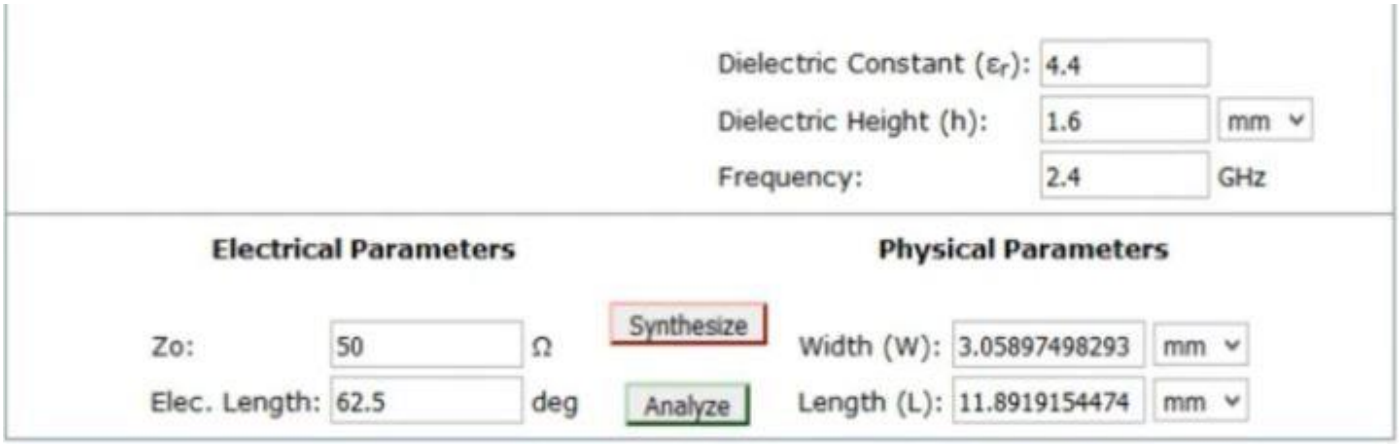


Figure 5: Feed line width calculator for 50-ohm line

Length of feedlines are not dependent on impedance only width matters.

Length and width of ground plane is greater than patch by 6h.

Where h = height or thickness of substrate

6h = 6*1.6 =9.6

Dimension of substrate are same as dimension of ground plane along with height or thickness.

All faces of radiation box are quarter wavelength away from radiating patch.

Quarter wavelength = lamda / 4 = 31.25.

RESULT:

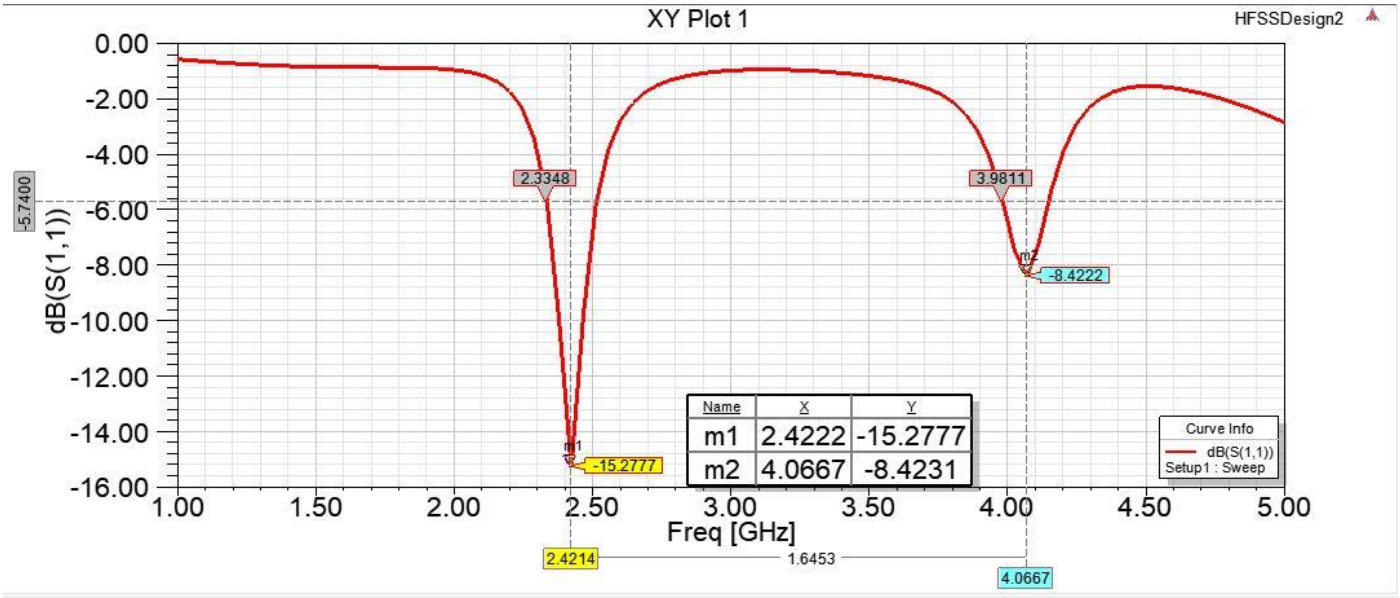


Figure 6: dB (S (1,1)) XY Plot

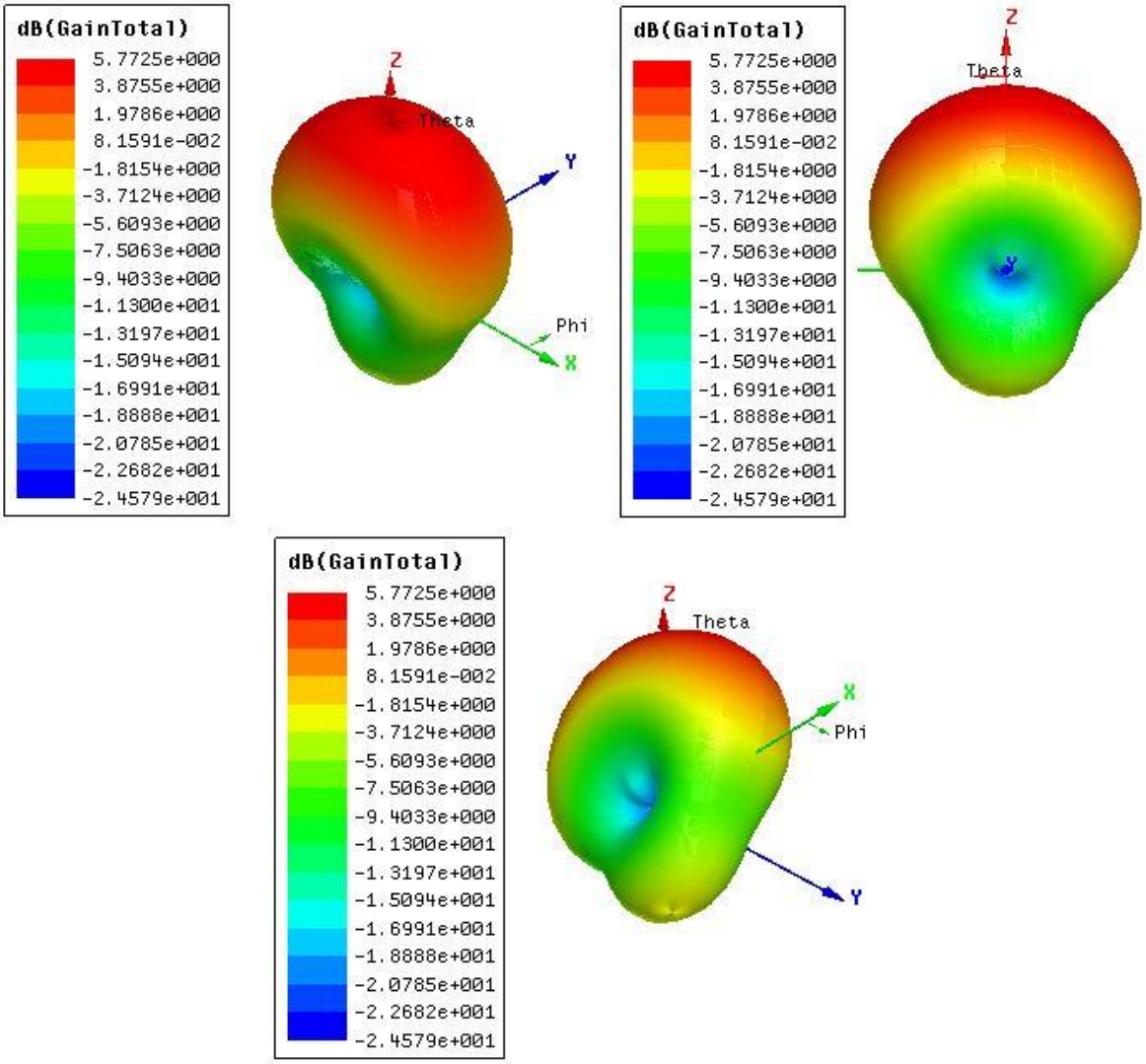


Figure 7:3D Polar Plot

CONCLUSION:

In this project I learned to use ANSYS HFSS software to design & simulate antenna. I also learned about designing and working of circular patch array antenna.

REFERENCES:

http://www.ijirset.com/upload/2017/august/192_53_Paper%201%20IJIRSET.pdf

https://www.youtube.com/watch?v=8sl2gT5JPEs

https://www.youtube.com/watch?v=YZhV523iaMs

https://www.youtube.com/watch?v=igONociHNew&t=39s